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A Preliminary Account of the Raspberry Aphids

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A PRELIMINARY ACCOUNT OF THE RASPBERRY APHIDS

J. D. WINTER

INTRODUCTION

Aphids are mentioned frequently in published data as vectors of mosaic and other virus diseases. The data often show that a definite relationship exists between a specific virus and one or more species of aphid. For example, several species may occur on a given food plant but only one may be able to transmit a specific virus disease.

The writer became interested in the aphids of the bramble fruits because of the wide distribution of virus diseases in cultivated plantings of these fruits. Much investigational work on these diseases has been done in recent years. In the bramble fruits the injection of plant juices from diseased plants has failed to transmit virus infection. Inoculation has been successful only with the use of aphids as vectors.

A search of the literature failed to disclose any publication dealing with the bramble fruit aphids as a group, or giving a general survey of species and distribution. Only recently have these aphids been considered of economic importance and little work has been done with them from this viewpoint. An attempt has been made, therefore, to bring together a complete record of the bramble fruit aphids of North America and Europe, including their synonomy and host plant species.

The brambles, which comprise the genus Rubus, consist of many distinct forms and an almost endless number of intermediate forms. Much confusion and uncertainty in the taxonomy of this group are the result. Bailey (1916) states that more than 3,000 species have been named, of which at least 400 are well defined forms. The genus is widely distributed in North America, where at least 100 species have been described. The horticultural varieties grown in North America for their fruit are derived principally from American and European species of Rubus.

Grateful acknowledgment is made to Professor A. G. Ruggles, of the Division of Entomology and Economic Zoology, for his many helpful suggestions and his kindness in extending facilities for the work; to Dr. C. E. Mickel, of the same division, for advice and suggestions on various problems, especially those relating to taxonomy; and to Dr. O. W. Oestlund, of the Department of Animal Biology, for much kindly advice and assistance.

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APHIDS RECORDED ON RUBUS IN NORTH AMERICA

Their Synonomy and Host Plants

Ten species of aphids are recorded as feeding on Rubus in North America. Only five of these are of wide distribution—*Amphorophora rubi, Amphorophora rubicola, Amphorophora sensoriata, Aphis rubicola,* and *Cerosipha rubifolii.* The literature mentions *Aphis rubiphila* Patch as being of wide distribution, but the writer (1929) considers this aphid identical with *Aphis rubicola* Oestlund. The blackberry aphid, *C. rubifolii,* is usually the only species that causes any appreciable direct injury to the host plant.

The records of two species included—*Macrosiphum ambrosiae* and *Pemphigus rubi*—indicate the probability that they were accidentally on Rubus when collected. In the literature it is common to find aphid species described as living on certain host plants on the strength of limited observation, in some instances on the collection of a single specimen. The writer believes that many unwarranted conclusions are thus reached that would be disproved by further study. During this study 16 additional species were taken on Rubus. The tribes Macrosiphini, Aphidini, Callipterini, and Anoeciini were represented in these collections. These 16 species are apparently distinct and none agree with the description of any of the species heretofore recorded on Rubus in North America. With three exceptions, not more than one specimen of the same species was taken in four years. The writer considers these specimens as accidentally on Rubus when collected.

Only one species is common to both Europe and North America. With the exception of the questionable record of *Macrosiphum ambrosiae,* these aphids have not been recorded on any food plant other than *Rubus sp.* in North America.

Genus AMPHOROPHORA[1]

Amphorophora davidsoni Mason

Amphorophora rubi (Kaltenbach) Swain (not *rubi* Kaltenbach), Univ. Calif. Pub., Ent. vol. 3, no. 1, 1919, p. 54

Amphorophora davidsoni Mason, Proc. U. S. Nat. Museum, vol. 67, art. 20, 1925, p. 26

Mason (1925) describes this species and reports it taken in 1911 by Davidson, in California, on thimbleberry. This probably refers to *Rubus parviflorus* Nuttall, syn. *R. Nutkanus* Moc. Mason believes the specimens that Swain (1919) described as *rubi* Kalt. to be this species. Swain reports specimens taken occasionally on thimbleberry in California.

[1] Mason (1925) has been followed with respect to the species included under the genus Amphorophora.

Amphorophora maxima Mason

Amphorophora maxima Mason, Proc. U. S. Nat. Museum, vol. 67, art. 20, 1925, p. 35

Mason (1925) describes this species from a single alate specimen and several nymphs taken in 1911 on salmonberry in California. The food plant referred to is probably either *Rubus spectabilis* Pursh or *R. parviflorus*. The specimens were taken in August and constitute the only record of this species.

Amphorophora reticulata Mason

Amphorophora reticulata Mason, Proc. U. S. Nat. Museum, vol. 67, art. 20, 1925, p. 51

Mason (1925) describes this species from one alate viviparous female taken by Pergande, July, 1907, on raspberry in Washington, D. C. This species is distinguished from *A. rubi* by its smaller size; by the longer antennae, which are dark colored and more than twice as long as the body; by the cornicles, which are very distinctly reticulate at the tip; and by the fewer number of sensoria (20 on the specimen described) on antenna III.

Amphorophora rubi (Kaltenbach)

Aphis rubi Kaltenbach, Monographie der Familien der Pflanzenlause, 1843, p. 24

Siphonophora rubi (Kaltenbach) Koch, Die Pflanzenlause Aphiden, 1854, p. 191

Nectarophora rubi (Kaltenbach) Oestlund, Minn. Geol. and Nat. Hist. Surv. Bull. 4, 1887, p. 87

Macrosiphum rubi (Kaltenbach) Del Guercio, Nuove Rel. Staz. Firenze, ser. 1, no. 2, 1900, p. 159

Amphorophora rubi (Kaltenbach) Schouteden, Mem. de la Soc. Ent. de Belg., vol. 12, 1906, p. 242

Eunectarosiphon rubi (Kaltenbach) Del Guercio, Redia, vol. 9, 1913, p. 188

Rhopalosiphum rubi (Kaltenbach) Van der Goot, Beit. kennt. der Holland, Blattlause, 1915, p. 153

Acyrthosiphon (*Amphorophora*) *rubi rubi* (Kaltenbach) Mordvilko, Fauna de la Russie, 1919, p. 251

Nectarosiphon rubi (Kaltenbach) Patch, Conn. St. Geol. and Nat. Hist. Surv. Bull. 34, 1923, p. 310

Amphorophora rubi (Kaltenbach) Mason, Proc. U. S. Nat. Museum, vol. 67, art. 20, 1925, p. 52

This appears to be the most widely distributed of all aphids recorded on Rubus and is the only species common to both Europe and North

America. It is found on the leaves and canes of Rubus throughout the summer. The following food plants are recorded for this species:

Rubus caesius Linn. Kaltenbach 1843
Rubus corylifolius. Kaltenbach 1843
Rubus discolor. Kaltenbach 1843
Rubus fruticosus Linn. Kaltenbach 1843, Buckton 1876, Theobald 1917
Rubus idaeus Linn. Kaltenbach 1843, Buckton 1876, Theobald 1917
Rubus loganbaccus Bailey. Davidson 1912
Rubus occidentalis Linn. Gillette 1911, Guyton 1924
Rubus parviflorus Nutt. Davidson 1914 syn. *R. Nutkanus* Moc.
Rubus saxtalis Linn. Patch 1918
Rubus strigosus Michx. Oestlund 1886, Patch 1914
Rubus vitifolius Ch. and Schl.[2] Essig 1917
Blackberry. Thomas 1879
Blackberry, cultivated. Essig 1917, Shinji 1917, Davidson 1912
Blackberry, wild. Shinji, 1917
Cytisus scoparius Link. Buckton 1876 syn. *Sarothamus scoparius* Wim.
Epilobium montanum Linn. Davidson 1925
Geum urbanum Linn. Davidson 1925

Mason (1925) believes that *Macrosiphum fragariellum* Theobald is identical with *A. rubi* Kalt., altho stating that Mordvilko considers it a subspecies, *A. rubi fragariellum.* Theobald (1926) states that *fragariellum* is common in Europe and lives entirely on the strawberry, the eggs being found on that plant. Mason includes a translation of Mordvilko's key, which separates *rubi* into four subspecies. Two of these subspecies, *rubi amurense* and *rubi zhuravlevi,* are considered distinct species by Mason. According to Laing, Buckton's material collected on *Sarothamus scoparius* is the species *pisi.* Theobald (1926) says that the species taken by Walker on *Geum urbanum* is *gei* Koch, and believes that *rubi* feeds only on *Rubus sp.* In North America, *rubi* has not been taken on any food plant other than *Rubus sp.*

Amphorophora rubicola (Oestlund)

Macrosiphum rubicola Oestlund, Minn. St. Geol. Rept. 14, 1886, p. 27
Nectarosiphon rubicola (Oestlund) Kirkaldy, Canad. Ent., 1906, p. 12
Nectarosiphum rubicola (Oestlund) Essig, Univ. Calif. Pub. Ent., vol. 1, no. 7, 1917, p. 329

[2] Essig records the specimens taken on wild blackberry (*R. vitifolius*). As *R. vitifolius* is a dewberry, this record perhaps should be listed under blackberry.

Amphorophora rubicola (Oestlund) Davidson, Jour. Econ. Ent., 1914, p. 136

This species is widely distributed in North America. It is not believed to have an alternate host plant. The following food plants are recorded:

Rubus occidentalis Linn. Guyton 1924
Rubus parviflorus Nutt. Essig 1917, Swain 1919
Rubus strigosus Michx. Oestlund 1886, Patch 1914

Amphorophora sensoriata Mason

Amphorophora sensoriata Mason, Proc. Ent. Soc. Wash., vol. 25, no. 9, 1923, p. 188

This species is widely distributed in North America on the black raspberry but is not often found on the red raspberry. It has been taken occasionally by the writer on black raspberry in Minnesota, where it occurs in strong colonies that feed on the terminal leaves and canes. This aphid is readily distinguished from *rubi* and *rubicola* by the shorter cornicles and the more numerous sensoria in both alate and apterous forms. It has been collected on Rubus throughout the growing season and is believed not to have an alternate host plant. Dr. C. W. Bennett, in a letter to the writer, states that this species has appeared every season for three years in cages where only raspberries and a small amount of June grass were present.

Genus APHIS

Aphis rubicola Oestlund

Aphis rubicola Oestlund, Minn. Geol. and Nat. Hist. Survey, Bull. 4, 1887, p. 60
Aphis rubiphila Patch, Maine Agr. Exp. Sta. Bull. 233, 1914, p. 269

This species is recorded as common on the red raspberry and is widely distributed in North America. Swain (1919) states that Davidson, in 1916, found specimens believed to be *rubicola* on loganberry and blackberry in California. The writer has collected this species on cultivated black raspberry.

Genus CEROSIPHA

Cerosipha rubifolii (Thomas)

Sipha rubifolii Thomas, 8th Rept. State Ent. Ill., 1879, p. 121
Cerosipha rubifolii (Thomas) Davis, Jour. Econ. Ent. vol. 3, 1910, p. 492
Aphis rubi Bennett, Mich. Agr. Expt. Sta. Tech. Bull. 80, 1927, p. 14

This is the common blackberry aphid and is widely distributed on the blackberry in North America. It causes a characteristic curling

of the foliage, particularly on the young leaves near the tips of the canes. Sanborn (1904) reports this species on the cultivated blackberry in Kansas; Davis (1910), on the wild and cultivated blackberry in Illinois; Baldwin (1912), on the wild blackberry in Indiana; and Guyton (1924), on the blackberry in Ohio. This species has not been recorded from Minnesota altho it is probably present but has been confused with *Aphis rubicola.* Wilson and Vickery (1918) list *Rubus occidentalis* and *R. villosus* as food plants of this species. *R. villosus* is probably the cultivated blackberry mentioned by Sanborn and others.

The writer observed that the published descriptions of this species coincided wtih the description of *Aphis rubicola* except that the antennae of *rubifolii* have only five segments. The location of the primary sensoria indicates that segments III and IV are merged. Upon inquiry, the writer found that there are no slides of *rubifolii* in the Thomas collection with the State Natural History Survey at Urbana, Illinois. Undoubtedly the type for this species is lost. A slide containing three alate viviparous females was kindly loaned to the writer by Dr. T. L. Guyton. These specimens were compared with *rubicola* and found apparently identical in every respect with the exception of the merged antennal segments. Dr. C. W. Bennett, who has worked with aphids in the transmission of virus diseases, states, in a letter to the writer, that *rubicola* usually will not satisfactorily live and reproduce on any variety of blackberry that he has worked with, while no difficulty is found in this respect with the common blackberry aphid. The blackberry aphid referred to by Bennett (1927) as *Aphis rubi* is undoubtedly *rubifolii,* altho no material is available for examination. This indicates strongly that *rubicola* and *rubifolii* are distinct species.

Genus MACROSIPHUM

Macrosiphum ambrosiae (Thomas)

Siphonophora ambrosiae Thomas, Ill. State Nat. Hist. Bull. 2, 1878, p. 4

Nectarophora ambrosiae (Thomas) Oestlund, Geol. and Nat. Hist. Surv. Minn. vol. 4, 1887, p. 84

Macrosiphum ambrosiae (Thomas) Cockerell, Canad. Ent. vol. 36, 1904, p. 262

Tritogenaphis ambrosiae (Thomas) Oestlund, 19th Rept. State Ent. Minn. 1922, p. 142

Macrosiphum ambrosiae (Thomas) Soliman, Univ. Calif. Pub. Ent., Bull. 4, no. 6, 1927, p. 110

Thomas, in his original description of this species, records it from Iowa on *Ambrosia psilostachya* DeCand. Sanborn, in his Kansas Aphididae, records it on white snakeroot, *Eupatorium ageratoides.* Oestlund (1887) reports it common on *Ambrosia trifida* Linn. Gillette

(1911) reports it abundant on this food plant and also taken on *Iva xanthifolia* and *Rudbeckia sp.* Swain (1919) reports what was probably this species on *Helianthus annus* Linn. Davis (1913) remarks that this species may be identical with *M. rudbeckiae* Fitch. Soliman (1927) states that the species recorded by Sanborn is not *M. ambrosiae* (Thomas). No mention is made by these authors of this aphid occurring on Rubus. Wilson and Vickery (1918) record this species on *Rubus villosus.* Owing to the meager records of this aphid on Rubus, it appears probable that its occurrence on Rubus was accidental.

Genus PEMPHIGUS

Pemphigus rubi (Thomas)

Pemphigus rubi Thomas, 8th Rept. State Ent. Ill., 1879, p. 147

Thomas, in his original description, reports this species on the under side of leaves of *Rubus occidentalis* in Illinois. He states that the specimens may have been accidentally on the raspberry and that they closely resemble specimens found on *Populus tremuloides,* probably *Pemphigus populicaulis* Fitch. No winged forms were found. Davis, in his list of the Aphididae of Illinois, in 1910, states that there is no reference to the collection of this species since the original description by Thomas. It appears probable that Rubus is not a normal food plant for this aphid. Davis (1913) gives a further description of the Thomas specimens, with figures.

APHIDS RECORDED ON RUBUS IN EUROPE

Their Synonomy and Host Plants

Six species of aphids are definitely recorded as feeding on Rubus in Europe. Six additional species have been mentioned but the available records indicate that these six species do not feed normally on Rubus. Only one of the aphids found in Europe has been recognized in North America.

Genus AMPHOROPHORA

The only species of Amphorophora recorded in Europe is *Amphorophora rubi* (Kalt.). This species is widely distributed in Europe and in North America. The synonomy and list of host plants are given under the species found in North America.

Genus APHIS

Aphis idaei Van der Goot

Aphis idaei Van der Goot. Tijdschr. voor Ent. 55, 1912, p. 78

According to Davidson (1925) this species is recorded several times on *Rubus idaeus* in Europe. Van der Goot records finding it on *Rosa sp.*

Aphis mordwilkiana Dobrowljansky

Aphis mordwilkiana Dobr. Kiev. Ent. Sta. South-Russian Agr. Syndicate, 1913, p. 34

According to Wilson and Vickery (1918), this aphid is recorded on *Rubus sp.* This is the only food plant recorded.

Genus MACROSIPHUM

Macrosiphum poae (Macchiata)

Siphonophora poae Macchiati, Bul. Soc. Ent. Ital., 17, 1885, p. 62

Macrosiphum poae (Macchiati) Wilson and Vickery, Tr. Wisc. Acad. Sci., 19, pt. 1, p. 132

According to Wilson and Vickery (1918), this species is reported on *Rubus idaeus, Bromus sterilis* Linn., and *Poa annua* Linn.

Macrosiphum rubiellum Theobald

Macrosiphum rubiellum Theobald, Jour. Econ. Biol., 8, 1913, p. 147

Theobald (1926) states that this species is found on blackberry and raspberry until July, when alatae appear and migration occurs. He states that it apparently migrates to several alternate host plants, but species of *Galium* seem to attract it most. He records this aphid in England on *Rubus fruticosus, R. idaeus, Galium aparine,* and *Galium sp.*

Macrosiphum rubifolium Theobald

Macrosiphum rubifolium Theobald, Ent. vol. 50, 1917, p. 78

Theobald (1917) describes this species and records it in England on *Rubus fruticosus* and *Rubus idaeus.* Theobald (1926) mentions that this species bears a strong structural resemblance to *M. rosae.* He also states that Buckton's *Macrosiphum chelidonii,* which Buckton recorded on raspberry, is not Kaltenbach's *chelidonii* but is apparently *rubifolium.*

Other Aphids Mentioned as Feeding on Rubus

Buckton (1876) records *Macrosiphum cyparissiae* Koch on *Rubus sp.* Theobald (1926) states that Buckton's slide is in poor condition but that it looks like *M. rubifolium.* Wilson and Vickery (1918) list *cyparissiae* as feeding on *Rubus sp.* and other plants.

Wilson and Vickery (1918) list *Macrosiphum funesta* (Macchiati) as questionable on *Rubus idaeus.* This is the only food plant listed.

Buckton (1876) records *Macrosiphum chelidonii* (Kalt.) on raspberry, but Theobald (1926) states that the species recorded by Buckton on Rubus is apparently *M. rubifolium.* Wilson and Vickery (1918) and Davidson (1925) list *chelidonii* as feeding on *Rubus sp.*

Patch (1918), Wilson and Vickery (1918), and Davidson (1925) list *Hyalopterus trirhoda* (Walker) as feeding on *Rubus sp.* and other

plants. Theobald (1926) does not include *Rubus sp.* as a food plant for this aphid.

Wilson and Vickery (1918) and Davidson (1925) list *Aphis urticaria Kalt.* as feeding on *Rubus sp.* Theobald (1926) states that this species has been confused with *Aphis idaei* with reference to the specimens collected on Rubus.

Davidson (1925) lists *Aphis urticae* Fabr. as feeding on *Rubus sp.* and other plants. Theobald (1926) mentions that it is impossible to determine the identity of this species described by Fabricius in 1775, altho the *urticae* Fabr. recorded by Roberts in 1915 is *urticaria* Kalt.

NOTES ON THE BIOLOGY AND MORPHOLOGY OF AMPHOROPHORA RUBI (KALTENBACH), AMPHOROPHORA RUBICOLA (OESTLUND), AND APHIS RUBICOLA OESTLUND

Amphorophora rubi (Kaltenbach)

This large-bodied species is the most active of the raspberry aphids found in Minnesota. When disturbed it moves readily and sometimes drops to the ground. Fluctuations in population are great, as might be expected, owing to the rapid rate of reproduction and the defenceless nature of the aphid against various enemies and unfavorable climatic conditions. After a period of hot, dry weather this aphid is often difficult to find in cultivated plantings. At other times large numbers may be found. In plantings where this species was unusually abundant, counts at various times averaged from 10 to 15 aphids per leaf, the leaves being selected at random from the tip of the canes. The abundance of this species is not correlated with the season of the year. Counts made in certain plantings about August 15, 1925, averaged as high as 14 aphids per leaf, altho they are usually not abundant in August.

In Minnesota this aphid is commonly found in plantings of cultivated red raspberry, but is not infrequent on the wild red raspberry and has been noted occasionally on the black raspberry and the cultivated dewberry. The favorite feeding place is the under side of the young leaves at the tip of the canes. Sometimes they feed directly on the young canes. It is not found in colonies as is *Amphorophora rubicola.*

Winged forms are not common in Minnesota in summer. They have been taken from time to time in June, July, August, September, and October, the latest record being November 1, at University Farm in 1928. Apterous forms are common on the raspberry throughout the growing season, viviparous females being taken as early as June 15 at

Lake City in 1928. Alate males were taken on wild red raspberry at La Crescent on October 7, 1926, and in the greenhouse during the last half of October, 1928. Oviparous females were taken on cultivated red raspberry at Wayzata on October 16, 1925, at Byron on October 18, 1928, and in the greenhouse in the last half of October, 1928.

The eggs are not laid in large numbers and are difficult to find. Apterous viviparous females were reared from eggs on the canes of cultivated red raspberry collected at Duluth on May 5, 1927. On October 12, 1928, oviparous females were observed depositing eggs on some cultivated red raspberries being grown in the plant pathology greenhouse at University Farm. The majority of eggs were deposited on the under side of the leaves, altho a careful search revealed an occasional egg on the cane. Many alate males were found at the same time.

On October 13, 1928, three oviparous females were taken and placed in separate shallow glass containers with fresh raspberry leaves. The tops of the containers were covered with cheese-cloth and the leaves were kept properly moistened. Observation showed that the eggs were produced singly and at a slow rate. One individual died after the production of one egg; the other two each produced six eggs at an average interval of 7 to 11 hours, as shown in Table I.

TABLE I

OVIPOSITION OF TWO SPECIMENS OF *Amphorophora rubi*

1928	No. 1	No. 2
Oct. 13, 4:00 p.m.	1st egg deposited	
" 14, 10:00 a.m.	2d and 3rd eggs found	
12:00 noon		1st egg deposited
7:00 p.m.	4th egg found	2d egg found
" 15, 10:00 a.m.	5th egg found	3rd and 4th eggs found
2:30 p.m.		5th egg deposited
" 15, 9:00 a.m.	6th egg found	6th egg found
" 18	Both aphids died	

The eggs were greenish white when deposited. The first eggs began to turn black at 4:00 p.m., October 17, and were completely black by noon of October 20, at which time they measured 0.67 to 0.76 mm. in length and 0.30 mm. in width. By November 1 they had shrunk slightly, measuring 0.65 to 0.70 mm. x 0.27 mm.

Amphorophora rubicola (Oestlund)

Mason (1925) records this species taken in March, April, and May in California; in July in Minnesota, British Columbia, and at Ottawa, Canada; in August in Maine; in October in Ontario. Oestlund mentions finding this species in Minnesota as late as November 1. The writer has taken alate and apterous forms in Minnesota throughout the growing season, from June to October. In 1925, alate males were taken

as early as September 15 in the vicinity of Duluth on the wild red raspberry. There are no published records that the eggs have been observed.

In Minnesota this aphid is found most commonly on the wild red raspberry in the northern part of the state, where it is often abundant. It is not often found in cultivated plantings. Winged forms are more often seen than are winged forms of *rubi*. This aphid is readily distinguished from *rubi* by exceptionally long cornicles, which are decidedly longer than segment III of the antenna. Also by the conspicuous dusky spot at the tip of the front wings. In contrast to *rubi* it is markedly gregarious, and strong colonies are often found on the under side of leaves and on the canes near the tip of the new growth.

In describing the alate male, Mason (1925) had only one specimen, which had lost one antenna and all but part of segment III of the other. The antenna of the alate male is decidedly longer than the body and is dark colored except at the base of III. Antenna III is obviously shorter than the cornicles, with 50 to 60 circular sensoria; IV has none; and V has 8 to 10 sensoria.

Mason (1925), who apparently had only two specimens for observation, states that the apterous viviparous female has 13 to 15 sensoria on the basal half of III. The writer found that the sensoria on III varied from 7 to 17 in number and that they often extended somewhat beyond the basal half.

Aphis rubicola Oestlund

This species is readily distinguished by its small size from other aphids common to the raspberry in Minnesota. It is widely distributed on both wild and cultivated plants but appears to reach its greatest abundance on the wild red raspberry, *Rubus strigosus*. Observations made at Two Harbors, on September 12, 1925, where this species was unusually abundant, showed a maximum of 219 on a single leaf of the wild red raspberry. Twenty leaves taken at random averaged 54.7 per leaf.

This aphid is found on the under side of the leaves of red and black raspberries. It is not active and moves very little so long as the portion of the plant on which it is present remains suitable for food. Winged forms sometimes are quite numerous during the summer. Apterous forms are found on the raspberry throughout the growing season, from June to October. A decided preference is shown for certain cultivated varieties of the red raspberry, particularly Cuthbert, Golden Queen, and Sunbeam, according to field counts made at various times where several varieties were grown in adjoining rows.

Eggs of this species were collected in the spring of 1925 on cultivated red raspberry at Red Wing and were reared for identification,

alate viviparous females being obtained. Canes of the wild red raspberry covered with enormous numbers of the eggs were collected on May 5, 1927, near Duluth. Specimens of this lot also were reared for identification. It is not usual to find eggs in such quantities, not more than one to six being generally found around each bud. The eggs are shiny black and are found on the cane mostly in the axils of the leaves. They are well hidden in the crevice formed by the bud except when they are numerous and are found on other portions of the cane. The eggs collected in the spring measure 0.43 to 0.49 mm. in length and 0.22 mm. in width. They begin to hatch when the buds first show green.

DISTRIBUTION AND MOVEMENT OF WINGLESS FORMS OF AMPHOROPHORA RUBI (KALTENBACH)

The distribution and movement of wingless forms of *Amphorophora rubi* are of special importance because winged forms are not abundant during the summer months and this species is known to be the principal vector of the mosaic group of virus diseases of bramble fruits. The distribution of wingless forms is limited by the distance they may be able to crawl or may be carried by some agency.

Agencies of Distribution

The possible agencies of distribution from plant to plant or from one planting to another are rain, wind, animals, birds, and persons, and equipment for the care and culture of raspberry plantings. No data are available on the possible distribution of *rubi* by animals or birds, but these factors are probably of little consequence. Wind is not likely to be an important factor in the distribution of wingless forms from one planting to another. The writer is informed by F. M. Wadley, J. E. Dudley, Jr., and others who have used tanglefoot screens extensively, that wingless aphids are usually not taken on these screens except close to the ground. It is possible that leaves bearing aphids occasionally may be carried a considerable distance by strong winds. Aphids may be carried on plants or plant parts removed from a planting or taken from one place to another. Observations show that *rubi* is frequently carried on the clothes of berry pickers and other workers who come in close contact with bushes on which this aphid is abundant.

Factors Causing Dislodgment from Foliage

Rankin (1927) found that rains may dislodge large numbers of *rubi* but that after rains of short duration they soon return to the bushes. It is probable that strong winds will dislodge some of them, altho no data on this point were obtained.

To determine whether aphids are dislodged when the foliage is disturbed, a white sheet was spread under individual bushes and a single-tree, such as is used with a cultivator, was brushed past the bush, approximately as if a horse cultivator were passing down a narrow row. The plants used were two years old in a planting of red raspberry at Nevis. A considerable number of *rubi* were found, but no data were obtained as to the number on each bush. Forty aphids were dislodged from the 10 bushes used in this experiment, as shown in Table II.

TABLE II
DISLODGMENT OF *A. rubi* WHEN FOLIAGE IS DISTURBED

Date	Number of bushes	Number of aphids dislodged			
		Maximum	Minimum	Average	Total
July 19, 1926	10	10	0	4	40

To determine whether aphids are dislodged when a plant is removed by digging, 8 bushes were surrounded with a white sheet on July 20 and 21, 1926, at Nevis. The canes were cut off at the surface of the ground with a pair of pruning shears and were placed on the sheet as they were cut. The canes were handled in approximately the same way as when a plant is dug. As soon as all canes were cut they were lifted from the sheet and carried away. Forty-two aphids were found on the sheet and 189 on the foliage of the canes carried away. This indicates that in the ordinary process of roguing all the aphids are not removed with the rogued plant. The maximum temperature in the shade at the time of this experiment was 29 degrees C.; the minimum 20 degrees C.

Behavior When Dislodged from Foliage

To determine the behavior of *rubi* when dislodged and thrown to the ground, many individuals were studied. Adult forms were very active and crawled from 4 to 5 feet in 8 to 15 minutes. They will ascend anything in their path—a dead twig, a toothpick, the stem of a weed, a raspberry cane, or similar material. If it is something upon which they can not feed, they crawl down and proceed on their way. If it is a living raspberry cane with foliage they will invariably remain and feed. They appear to have no sense of direction or attraction toward raspberry canes that may be close at hand. This behavior probably explains why the virus infection that *rubi* is known to transmit spreads mostly to adjoining plants rather than at random through a planting. Aphids feeding on an infected plant, if disturbed and thrown to the ground, will either return to the same bush or will ascend the first bush in their path rather than pass through adjoining bushes to more distant ones.

Distance and Rate of Movement on the Ground

The distance that wingless forms are able to crawl from one planting to another is limited by the activity of the aphid and by the time it can live without food, if we assume that no plants of the genus Rubus exist at intermediate points. On three occasions adult and partly grown *rubi* were confined in glass containers covered with cheese-cloth, with paper substituted for raspberry leaves. The maximum time that they were able to live without food was 50 hours. Most of them survived 40 to 50 hours, the average being about 45 hours. Similar containers with raspberry leaves kept properly moistened were used as checks, the majority of aphids being alive at 100 hours in each experiment.

The following experiment was made at Nevis on July 19 and 20, 1926, to determine the distance covered by the wingless forms of *rubi* in a given time on cultivated ground. Sixteen adults were carefully placed on the ground between two rows of raspberry plants. Their distance in a straight line from the starting point was recorded at stated intervals, no account being taken of backward and wandering movements. The sixteen aphids traveled 428 inches in 120 minutes, averaging 3.6 inches each per minute. The maximum time one individual was under observation was 30 minutes and the distance traveled was 63 inches. The maximum distance traveled by one individual was 86 inches in 26 minutes. The temperature in the shade during this experiment ranged from 38 degrees to 43 degrees C. It is found that under favorable conditions the average time an aphid can exist without food is about 45 hours. Therefore the average theoretical distance that it would be capable of traveling is 810 feet. Actually, the distance it is likely to travel is probably much less because of other factors such as obstructions, storms, heat, and the improbability that one would travel continuously and in a relatively straight line for a long time.

The data on dislodgment, distance, and rate of travel of *rubi* indicate that movement of wingless forms from one planting to another is not likely to occur if such plantings are a relatively short distance apart. It was found that distribution within a planting occurs when the foliage is disturbed by cultural operations and by digging of plants, and that this species may be carried on the clothes of persons from one planting to another. Citations are given to show that rain and wind may be factors of distribution within a planting but not from one planting to another.

Behavior When Leaves Become Wilted

The following experiment was made at Nevis in 1926 to discover the behavior of wingless forms of *rubi* feeding on plants that are dug and left on the ground. Ten leaves with aphids feeding upon them

were picked and placed on the ground. Care was taken to select aphids that were actually feeding and to disturb them as little as possible. Adult aphids were used except where noted. The data in Table III indicate that dispersal occurred as soon as the leaves began to wilt.

TABLE III
BEHAVIOR OF *A. rubi* WHEN LEAVES BECOME WILTED

Date commenced, 1926	Hour	Temperature in shade	Condition of leaves	Position of leaves	Aphids present
July 18	6:30 p.m.	30° C.	just picked	in shade	10
	8:00 p.m.		not wilted	"	9
	9:00 a.m.		wilted	"	0
" 19	11:00 a.m.	32° C.	just picked	in sun	10
	12:00 noon		partly wilted	"	2
	3:00 p.m.		wilted	"	0
" 19	11:00 a.m.	32° C.	just picked	"	42*
	12:00 noon		partly wilted	"	0
" 19	5:00 p.m.	33° C.	just picked	in shade	40
	6:15 p.m.		slightly wilted	"	28
	9:00 a.m.		wilted	"	0
" 20	8:30 a.m.	25° C.	just picked	"	16
	9:30 a.m.		not wilted	"	14
	11:30 a.m.		partly wilted	"	6
	4:00 p.m.		wilted	"	0

* Nymphs.

RESISTANCE OF THE HERBERT RASPBERRY TO AMPHOROPHORA RUBI (KALTENBACH)

According to Darrow (1920), most of the red raspberries cultivated in North America are derived from the native American red raspberry, *R. strigosus,* or from hybrids between this species and the European red raspberry, *R. idaeus.* Darrow presents evidence to show that the varieties Cuthbert, Golden Queen, and Herbert are derived from *R. strigosus* x *R. idaeus* and that the variety King is derived directly from *R. strigosus.*

It is well known that raspberry varieties differ materially in their susceptibility to virus disease infection. Casual observation showed that *rubi* seemed to have a decided preference for certain varieties, indicating the possibility of correlation between virus susceptibility and host plant resistance.

Field Counts of Population on Cultivated Varieties

To secure data on the subject of host plant resistance, field counts were made in 1927 and 1928 in plantings where several cultivated varieties were grown in adjoining rows. The counts were taken on 100 leaves of each variety selected at random from the top of the canes. The leaves were taken from about 75 feet of continuous row of each variety and mostly in the same plantings throughout the two years.

The data in Table IV indicate a consistent relation between aphid population and the host plant variety. Herbert appears extremely resistant to *rubi* altho it is of interest to mention that this does not apply to *Aphis rubicola*, which was often found but is not abundant on this variety. Cuthbert and Golden Queen appear to be intermediate in resistance between Herbert and the other varieties. At Howard Lake, the Herbert was grown between Latham and Golden Queen in adjoining rows. At Lake City, the Herbert was between Cuthbert and St. Regis. The counts on Herbert were checked several times by counting an additional 100 leaves, but no more aphids were found than in the original count.

TABLE IV

NUMBER OF *A. rubi* ON 100 LEAVES SELECTED AT RANDOM

Variety	Eveleth Aug. 3, 1928	Howard Lake July 26, 1927	Howard Lake Aug. 26, 1927	Howard Lake Aug. 18, 1928	Lake City July 23, 1928	Lake City Aug. 22, 1928	Lake City Sept. 16, 1928
Latham	92	75	38	21	227	27	12
King	..	84	29	19	280	40	16
Cuthbert	..	11	9	9	73	6	0
Golden Queen	..	6	11	18	70	4	3
Herbert	0	0	0	0	1	1	0
St. Regis	..	82	30	20	201	50	16
Sunbeam	..	82	21	28	..	..	..
June	66	..	..	..	..	..	..
Ontario	70	..	..	..	..	..	..

Comparison of Counts at Howard Lake and Lake City

Variety	Total leaves	Total aphids	Aphids per 100 leaves
King	600	468	78.0
Latham	600	400	66.7
St. Regis	600	399	66.5
Sunbeam	300	131	43.7
Golden Queen	600	112	18.7
Cuthbert	600	108	18.0
Herbert	600	2	0.3

Inability of A. rubi to Maintain Its Population on Herbert

To obtain further evidence on the relation between aphid population and the host plant variety, experiments were performed using potted plants of the varieties Herbert, King, and Latham of approximately the same size and in the same condition. These pots were kept in moist sand on a bench in the outdoor insectary at University Farm. Four-inch pots were used. Street-light globes large enough to hold three four-inch pots were used to separate the various lots. The tops were covered with a double thickness of cheese-cloth and the bottoms were embedded in the sand.

On July 30, 1928, one plant of Herbert, one of King, and one of Latham were placed under each of three of these globes. All aphids were removed, then six adult *rubi* were placed on each plant. A count

of the leaflets over one-half inch in length on August 10 showed: Herbert 90 leaflets, Latham 78, and King 58, indicating that more feeding surface was available on the Herbert than on either of the other varieties. The plants were so placed in each container that their leaves intermingled, affording easy passage of the aphids from one plant to another. The *rubi* on these plants were counted at various times, as shown in Table V. The results, as shown in Figure 1, indicate a distinct preference for Latham and King.

TABLE V

POPULATION OF *A. rubi* ON THREE VARIETIES GROWN IN THE SAME CONTAINER

Date, 1928	Container No.	Herbert		King		Latham	
		Adults	Nymphs	Adults	Nymphs	Adults	Nymphs
July 30	1	6	..	6	..	6	..
	2	6	..	6	..	6	..
	3	6	..	6	..	6	..
Total		18		18		18	
Aug. 2	1	2	4	2	17	5	45
	2	0	0	10	25	5	24
	3	1	1	3	20	11	76
Total		8		77		166	
" 10	1	0	14	0	69	0	58
	2	0	11	0	63	0	49
	3	0	15	0	42	0	123
Total		40		174		230	
" 15	1	3	24	3	80	2	52
	2	1	19	8	113	4	66
	3	4	22	5	78	4	63
Total		73		287		191	

On August 15 the King and Latham plants (Table V) were removed, leaving only the three plants of Herbert, which were placed in one container. The population of *rubi* decreased at once, as shown in Table VI and Figure 1.

TABLE VI

DECREASE IN POPULATION OF *A. rubi* ON THREE PLANTS OF HERBERT AFTER KING AND LATHAM PLANTS WERE REMOVED

Date, 1928	Herbert		
	Adults	Nymphs	Total
Aug. 15	8	65	73
" 21	4	43	47
" 25	2	36	38
Sept. 2	0	17	17
" 7	0	22	22
" 19	1	14	15

To determine the behavior of *rubi* when each variety is grown in a separate container, 3 plants each of Herbert, Latham, and King were placed under separate street-light globes on July 30, 1928. All aphids had been removed from these plants. Twenty *rubi* nymphs two to

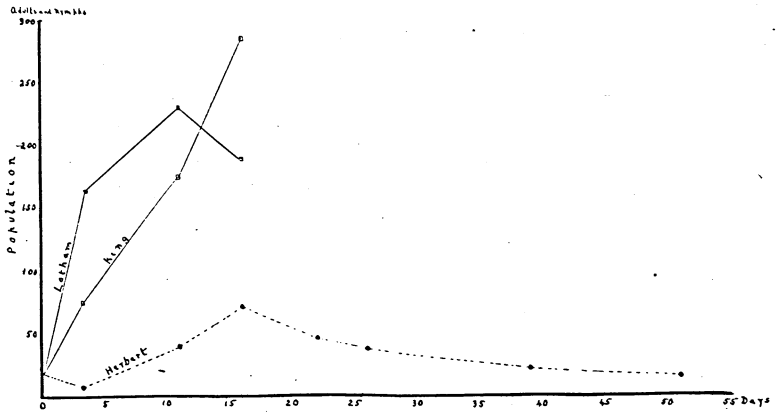

Fig. 1. Population of *A. rubi* on Three Varieties Grown in the Same Container (Table V). Latham and King Removed After 16 Days (Table VI)

three days old were then placed on each plant. A count of the leaflets over one-half inch in length on August 10 showed Herbert 113, King 48, and Latham 48. The *rubi* on these plants were counted at various times, as shown in Table VII. At such times in this and similar experiments all predators or other insect enemies of the aphid were removed. The results, as shown in Figure 2, indicate that *rubi* has great difficulty in maintaining its population on Herbert. There were more leaves on the Herbert than on the two other varieties combined. In spite of this, the population on King and Latham increased far above that on Herbert.

TABLE VII

POPULATION OF *A. rubi* ON THREE VARIETIES IN SEPARATE CONTAINERS, THREE PLANTS OF EACH VARIETY IN EACH CONTAINER

Date, 1928	Herbert		King		Latham	
	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs
July 30	..	60	..	60	..	60
Aug. 10	..	16	13	117	9	64
" 15	4	39	12	189	21	248
" 21	16	66	plants died		42	386
" 25	5	31	..	..	36	401
Sept. 2	5	29	..	..	11	187
" 7	1	20	..	..	3	131

1928	Adults and Nymphs		
	Herbert	King	Latham
July 30	60	60	60
Aug. 10	16	130	73
" 15	43	201	269
" 21	82	...	428
" 25	36	...	437
Sept. 2	34	...	198
" 7	21	...	134

The data given in Tables VI and VII indicate that *A. rubi* is unable to maintain its population on Herbert under the most favorable conditions—with young tender foliage to feed on and with predators and other insect enemies removed.

TABLE VIII

INCREASE OF *A. rubi* ON LATHAM RASPBERRY AND DECREASE ON HUBERT WHEN CONFINED IN INDIVIDUAL CAGES

Cage	July 30 adults	Aug. 2		Aug. 10		Aug. 15	
		Adults	Nymphs	Adults	Nymphs	Adults	Nymphs
Herbert raspberry							
1 to 10	10	0	0	..	..	..	..
11	1	1	2	0	0	..	..
12	1	1	0	leaf dead		..	..
13	1	1	0	0	0	..	..
14	1	1	0	0	0	..	..
15	1	0	1	0	0	..	..
16	1	1	2	0	0	..	..
17	1	1	0	0	0	..	..
18	1	1	0	0	0	..	..
19	1	1	0	0	1	0	0
20	1	1	0	0	0	..	..
Total aphids	20	9	5	0	1	0	0
Latham raspberry							
1	1	1	0	0	0	..	..
2	1	0	0	..	..	..	..
3	1	1	5	0	4	4	8
4	1	1	3	0	0	..	..
5	1	1	0	0	2	0	0
6	1	1	0	0	0	..	..
7	1	1	4	0	8	0	4
8	1	1	1	0	4	1	14
9	1	1	4	0	0	..	..
10	1	1	4	0	3	0	7
11	1	1	5	0	2	leaf dead	
12	1	1	2	0	1	0	0
13	1	0	0	..	..	..	..
14	1	1	0	0	11	0	1
15	1	1	2	0	5	0	2
16	1	1	5	1	19	0	7
17	1	1	0	leaf dead		..	..
18	1	1	0	0	0	..	..
19	1	1	2	0	3	0	4
20	1	1	0	0	1	0	0
Total aphids	20	18	37	1	63	5	47

The population on Latham increased to 4 adults and 53 nymphs by August 21.

SUMMARY OF TABLE VIII

1928	Herbert	Latham
July 30	20 adults	20 adults
Aug. 2	14 adults and nymphs	55 adults and nymphs
" 10	1 nymph	64 adults and nymphs
" 15	0	52 adults and nymphs
" 21	0	57 adults and nymphs

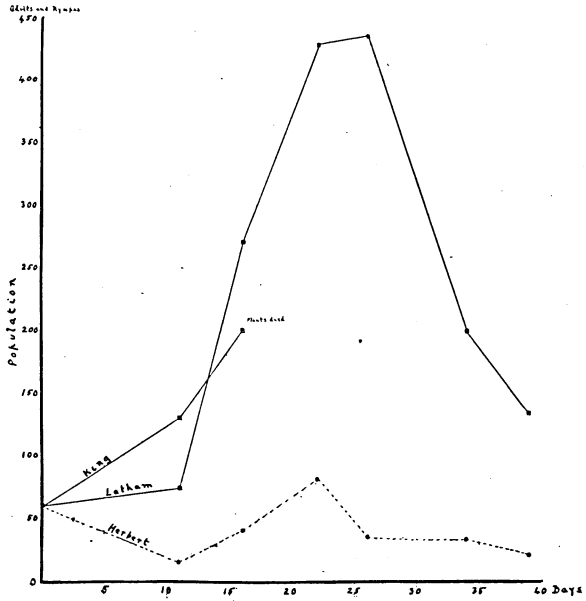

Fig. 2. Population of *A. rubi* on Three Varieties in Separate Containers (Table VII)

Experiments were made under conditions less favorable to the aphid. Each aphid was confined in a glass cage. These cages were obtained through the courtesy of Dr. Walter Carter, who used similar cages in sugar beet investigations. Each cage consists of a glass tube about 2 inches long and less than an inch in diameter. Both ends are open, one end being flared for convenience in covering with cheese-cloth. A metal disk is held by a spring wire against the other end so that the cage may be clamped to a leaf.

On July 30, 1928, twenty cages, each containing one adult *rubi,* were placed on young leaves of Herbert plants so that the aphids could feed on the underside of the leaves. The same number were placed on Latham plants. The aphids in these cages were counted at various times, as given in Table VIII. The aphids placed on Herbert failed to maintain themselves and were all dead after 16 days. Those on Latham increased to about three times their original number in three days and maintained this number for 22 days, when the experiment was discontinued.

To check the data shown in Table VIII a similar experiment was started on September 19, using 10 cages on Herbert and 10 on Latham, with one adult *rubi* in each cage. The data obtained are given in Table IX showing *rubi* unable to maintain its population on Herbert. The Herbert plants used to obtain the data given in Tables V and VI were used in this experiment.

TABLE IX

DECREASE OF *A. rubi* ON HERBERT RASPBERRY WHEN CONFINED IN INDIVIDUAL CAGES

1928	Herbert	Latham
Sept. 19	10 adults	10 adults
" 21	5 adults	10 adults
" 24	2 adults	12 adults and nymphs
Oct. 1	1 adult	10 adults and nymphs

Another experiment to check the data shown in Table VIII was started on August 11, 1928, using *rubi* nymphs two to three days old instead of adults. Fifteen cages were placed on Herbert and 15 on Latham, each containing one nymph. The data given in Table X again show that the aphids placed on Herbert were unable to maintain their population. The data given in Tables VIII, IX, and X are shown in Figure 3.

TABLE X

POPULATION OF *A. rubi* ON LATHAM AND HERBERT RASPBERRY WHEN CONFINED IN INDIVIDUAL CAGES

Cage	Aug. 11 nymphs	Aug. 13 nymphs	Aug. 15 nymphs	Aug. 21 Adults	Aug. 21 Nymphs
Herbert raspberry					
1 to 15	15	1	0	..	..
Total aphids	15	1	0		
Latham raspberry					
1 to 5	5	0	..	..	.
6	1	1	1	0	0
7	1	1	1	0	0
8	1	1	1	1	6
9	1	leaf dead	..	..	..
10	1	1	1	1	5
11	1	1	0	..	..
12	1	1	1	0	0
13	1	1	1	0	0
14	1	1	1	0	6
15	1	1	1	0	0
Aotal aphids	15	9	8	2	17

1928	Herbert	Latham
Aug. 11	15 nymphs	15 nymphs
" 13	1 nymph	9 nymphs
" 15	0 nymphs	8 nymphs
" 21	0 nymphs	19 adults and nymphs

Possible Reasons for Resistance Shown by Herbert

It has been shown that the Herbert variety exhibits a marked resistance to the raspberry aphid, *Amphorophora rubi*. Under field conditions in Minnesota during 1927 and 1928 it seemed unable to exist on the Herbert raspberry, only two being found on 700 leaves selected at random, altho similar counts showed large numbers of this species on several other varieties growing in adjoining rows. Experiments

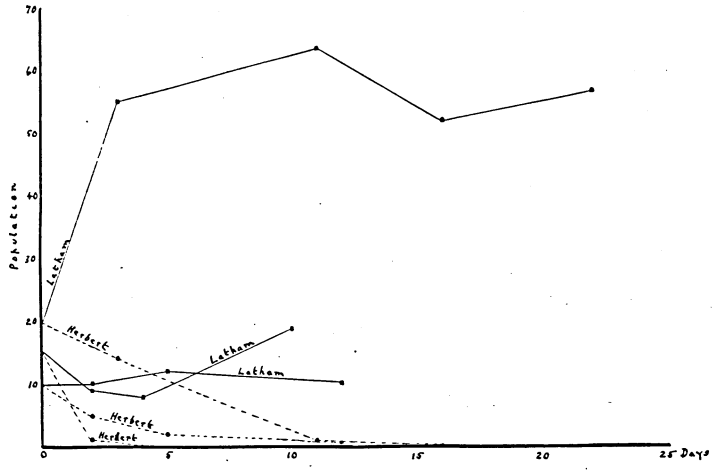

Fig. 3. Population of *A. rubi* on Herbert and Latham When Confined to Individual Cages (Tables VIII, IX, and X)

with potted plants showed that under favorable conditions *rubi* will feed and live on the Herbert variety for several weeks, but is unable to maintain its population. When confined to individual cages the decrease in population was very rapid.

Two possible reasons are suggested to account for the resistance shown by this variety. First, that the leaf of the Herbert is more difficult to penetrate than the leaves of other varieties used for comparison. Horsfall (1923) shows that the objective of the proboscis is always a vascular bundle and the tissue most commonly reached is the phloem, particularly the sieve tubes; also that the route followed by the proboscis indicates a trial and error method of reaching the bundle.

To obtain evidence on the resistance to penetration, adults and nymphs of *rubi* were placed on the under side of leaves of Herbert and Latham. A careful study was made of the time required to assume what appeared to be a normal feeding position with the proboscis fully inserted. No difference in the average time could be noted, the proboscis being inserted with apparent ease on both varieties. At the same time several *rubi* were observed feeding on the upper surface of Herbert leaves. As the cuticle invariably is much thicker on the upper surface, this indicates that thickness of cuticle is not a limiting factor.

Second, a difference in the food material is suggested to account for the resistance shown by the Herbert variety. It is possible that the food materials obtained from Herbert are less compatible to *rubi* than those from the other varieties used for comparison.

APHIDS RECORDED ON RUBUS ARRANGED UNDER THEIR HOST PLANT SPECIES

In compiling this food plant list the writer has endeavored to include all species of Rubus that are definitely recorded in the literature of North America and Europe as host plants of aphids. Every effort has been made to apply the correct botanical name for each host plant. In some instances there is much confusion in published records concerning the host species. Citations to the literature from which these data were obtained are given under the species list of aphids on pages 4 to 11. Several species mentioned in these pages are not included in this list as the data give reasonable assurance that these aphids do not live normally on *Rubus sp.*

Three distinct groups of cultivated forms of the genus Rubus are recognized—the raspberries, the blackberries, and the dewberries. Horticultural varieties of the raspberry grown in North America for their fruit are derived principally from three species, the common red raspberry, *R. strigosus* Michx.; the common black raspberry, *R. occidentalis* Linn.; and the European raspberry, *R. idaeus* Linn.; including hybrids of these species. Three other species are grown to a relatively slight extent—the wineberry, *R. phoenicolasius* Maxim.; the strawberry raspberry, *R. illecebrosus* Focke; and the yellow Himalayan raspberry, *R. ellipticus* Smith. The first two are the only species native to North America, altho in places other species have escaped from cultivation and become established. The blackberries and dewberries under cultivation are derived from a comparatively large number of species of Rubus and their hybrids. These fruits are not generally cultivated except in North America, and the horticultural varieties commonly grown are derived from American species.

Raspberries

R. idaeus Linn. European red raspberry
Amphorophora rubi (Kalt.) Recorded in Europe
Aphis idaei Van der Goot. Europe
Macrosiphum poae (Macchiati). Europe
Macrosiphum rubiellum Theobald. Europe
Macrosiphum rubifolium Theobald. Europe

R. occidentalis Linn. American black raspberry, Thimbleberry
Amphorophora rubi (Kalt.). North America
Amphorophora rubicola (Oestlund). North America
Amphorophora sensoriata Mason. North America
Aphis rubicola Oestlund. North America
Cerosipha rubifolii (Thomas). North America
Pemphigus rubi Thomas? North America

R. parviflorus Nutt. Salmonberry, Thimbleberry (syn. *R. nutkanus* Moc.)
Amphorophora davidsoni Mason. North America
Amphorophora rubi (Kalt.). North America
Amphorophora rubicola (Oestlund). North America
R. saxatilis Linn. Dwarf red raspberry
Amphorophora rubi (Kalt.). Europe
R. strigosus Michx.[3] Common (American) red raspberry
Amphorophora rubi (Kalt.). North America
Amphorophora rubicola (Oestlund). North America
Amphorophora sensoriata Mason. North America
Aphis rubicola Oestlund. North America
Red Raspberry, American cultivated
Amphorophora rubi (Kalt.). North America
Amphorophora rubicola (Oestlund). North America
Amphorophora sensoriata Mason. North America
Aphis rubicola Oestlund. North America
Raspberry (*Rubus sp.*) No other host data available.
Amphorophora reticulata Mason. North America
Salmonberry. (Probably *R. spectabilis* Pursh or *R. parviflorus* Nutt.)
Amphorophora maxim Mason. North America

Blackberries

On account of the large number of species and hybrids involved in both the wild and cultivated blackberry, it is not possible to name the probable species when specific names are not stated by the collector. Hedrick (1925) describes 29 species of blackberry native to North America, including 4 species naturalized from Europe. He mentions 8 species and their hybrids from which our horticultural varieties are derived.

R. fruticosus Linn. European blackberry
Amphorophora rubi (Kalt.). Europe
Macrosiphum rubiellum Theobald. Europe
Macrosiphum rubifolium Theobald. Europe
Blackberry (*Rubus sp.*) No other host data available.
Aphis rubicola Oestlund. North America
Blackberry, American native
Amphorophora rubi (Kalt.). North America
Cerosipha rubifolii (Thomas). North America
Blackberry, American cultivated
Amphorophora rubi (Kalt.). North America
Cerosipha rubifolii (Thomas). North America

[3] Hedrick (1925) considers *R. strigosus* a sub-species of *R. idaeus*. Rosendahl and Butters (1927) state that these are two distinct species.

Dewberries

Hedrick (1925) describes 18 species of dewberry native to North America including one species naturalized from Europe, and mentions 6 species and their hybrids from which are derived the horticultural varieties cultivated for their fruit. Most of the northern dewberries are derived from *R. flagillaris* including the variety Lucretia.

R. caesius Linn. European dewberry
Amphorophora rubi (Kalt.) Europe
R. flagillaris Willd. Northern dewberry (syn. *R. procumbens* Muhl.)
Amphorophora rubi (Kalt.). North America
R. Loganbaccus Bailey. Loganberry
Amphorophora rubi (Kalt.). North America
Aphis rubicola Oestlund. North America
R. villosus (Species uncertain, several synonyms)
Macrosiphum ambrosiae (Thomas)? North America

Rubus Sp.

Rubus. sp. No other host data available.
Aphis mordwilkiana Dobr. Europe
Rubus corylifolius
Amphorophora rubi (Kalt.). Europe
Rubus discolor
Amphorophora rubi (Kalt.). Europe

SUMMARY

A brief account is given of the aphids found on the bramble fruits in North America and in Europe including their synonomy and host plants. Five species are found widely distributed in North America. Five additional species are recorded, two of which are questionable records. Six species are found in Europe. Six other species are recorded in Europe under circumstances indicating that the bramble fruits are not their normal host. Only one species is common to North America and Europe.

Notes are given on the biology and morphology of three species of aphids common in Minnesota, *Amphorophora rubi* (Kaltenbach), *Amphorophora rubicola* (Oestlund), and *Aphis rubicola* Oestlund. Eggs of *A. rubi* and *Aphis rubicola* have been collected, and these two species have been followed on the raspberry throughout the year.

A study was made of the distribution and movement of wingless forms of *A. rubi*. It was found that this aphid may be carried on the clothes of persons from one raspberry planting to another and that

distribution occurs within a planting when the foliage is disturbed by cultural operations and by digging of plants. It is shown that this aphid does not remain on leaves that have wilted.

The Herbert raspberry exhibited a very marked resistance to *A. rubi.* Under favorable conditions, with its insect enemies removed, *rubi* will feed and live on the Herbert variety for several weeks but is unable to maintain its population. The population on check plants of other varieties invariably increased, often at a rapid rate.

Under field conditions, *rubi* seemed unable to exist on Herbert in the plantings where observations were made for two years, altho many were found on other varieties growing in adjoining rows. The proboscis of this aphid is inserted with apparent ease in the leaves of the Herbert variety, indicating that thickness of cuticle is not a limiting factor.

A list is compiled of the aphids recorded on Rubus in North America and in Europe, arranged under their host plant species.

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